

Water Resources - Experiment #2A
1.101 Sophomore Design - Fall 2006

Time-scale for neutralization by dissolution of calcium carbonate

In this exercise you will find the time required to neutralize acidic water by dissolution of solid calcium carbonate. You will consider three granular forms of calcium carbonate (Vical, AFG 10/40, C33). The time required to bring the water to $\text{pH} = 7$ will be called the Neutralization Time, T_N .

Procedure:

1. pH Sensor: Set-up pH sensor. Based on your calibration curve, make a note of the voltage reading that will correspond to complete neutralization ($\text{pH} = 7$).
2. Pre-wash sample: The process of pulverizing the calcium carbonate produces some fine dust. When contacted with acidic water, the dust will dissolve very quickly and provide very rapid neutralization. However, a treatment column must function for weeks or months, long after the initial dust has dissolved away. Therefore, you are interested in the neutralization produced by the material in the absence of the dust. BEFORE you begin analysis of any sample remove the dust by pre-washing it with mildly acidic water and mesh bags.
3. Prepare sample: After washing the sample, use gravity drainage to remove as much wash water as possible. Place approximately 400mL of the sample in the container shown below. The sample should have minimal pore water.



4. Begin Experiment: Have pH sensor ready. Add the acidic water until an excess of 1/2 inch of water exists above the material, as shown above left. Immediately begin measuring the pH in the layer of excess water above the grains. Insert the probe through the opening in the cap of the container, as shown above right. Remember, the sensor has a very thin glass membrane, so be careful to just insert it into the water and not the granular material.

5. Continue to measure pH as a function of time, at least until $\text{pH}=7$ and preferably until the pH stops rising. **IMPORTANT:** Between each measurement, carefully shake the bottle to ensure constant mixing. Record the Neutralization Time, T_N , with uncertainty.

6. Repeat the above process for each of the three materials

7. **What to hand in.** Please submit a summary of your Neutralization Time in table format. Include uncertainty. One submission per group is fine, but all group members should sign the submission. Also answer the following

7a. Does the neutralization time differ between the materials?

7b. If neutralization time differs between samples, explain this difference. Remember that all the material are the same chemical substance, calcium carbonate, and differ only in their grain size.